



THE SCIENCE OF BATTERY MONITORING

“Any solid state UPS system would be useless if it did not have a battery – just like a human without a heart!”

Professional Electrician Magazine

Welcome to NDSL's 'Science of Battery Monitoring' Bulletin

In recent years, battery monitoring has become an integral part of system continuity strategies for all organisations with medium to large UPS systems. But, in an era of such rapid technological advances and increased product reliability, are these monitoring systems really needed, and if so, what is their worth to the business world?

This bulletin will look at potential answers to these questions by assessing both the critical issues surrounding back-up power systems and the reliability of these systems. We need to ask:

- Are power problems really a common cause of computer failure?
- How susceptible are modern batteries to failure?
- What are the causes of battery failure?
- What are the best methods for guarding against battery failure?
- What are the cost benefits to a business that implements a battery monitoring system?
- How important is it to have a battery monitoring service partner?



ARE POWER PROBLEMS REALLY A COMMON CAUSE OF COMPUTER FAILURE?

It is easy to assume in today's world that power problems are a relatively minor occurrence. The statistics, however, prove otherwise. Leading uninterruptible power supply companies estimate that approximately 30% of server failures can be attributed to power failures; this figure is supported by the IDC Technology Integration Panel (1998). In fact, the U.S. National Power Laboratory estimates that an IT room may be subject to as many as 15 power failures, on average, every year.

The effects of power failure on a business can be catastrophic, with a third of companies that suffer a complete disaster taking at least a day to recover, and 10%, more than a week (US National Computing Center).

Research in the United States shows that only 43% of businesses that suffer a disaster ever resume business and only 29% of these are in business two years later. Of those businesses which lost their data centre for ten days or more, 93% went bankrupt within one year.



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“Any solid state UPS system would be useless if it did not have a battery – just like a human without a heart! But what if the battery system fails?”

HOW SUSCEPTIBLE ARE MODERN BATTERIES TO FAILURE?

Incredibly, only 30 per cent of 10-year life VRLA (valve regulated lead acid) battery cells achieve a life-span of 7 to 10 years, with a high proportion needing to be replaced within 4 to 6 years.

This failure rate is not due to sub-standard manufacturing, nor is it necessarily due to faulty installation.

Each VRLA cell relies on a specific amount of electrolyte absorbed in the microporous separators between the plates and the internal recombination of gases produced when charging and discharging. Each unit is sealed so that there is no access for the addition of electrolyte.

WHAT ARE THE CAUSES OF BATTERY FAILURE?

There are a variety of possible causes of battery failure, and some of these may, in fact, be linked.

Excessive gassing for instance is due to overcharging. This can occur if the temperature is too high. If the temperature is not sufficiently controlled then one part of the battery could be up to 10 degrees higher than another part with the result that the first part is overcharged and the second is undercharged – all in the one battery!

The 6 most common causes of battery failure are:

- High or uneven battery temperature
- Inaccurate float charge voltage (overcharge or undercharge)
- Loose intercell links or connections
- Loss of electrolyte due to cracked or bowed cases
- Lack of maintenance
- Plate corrosion

Examples of Possible Battery Problems and Causes

PROBLEM	CAUSE
Sulphation of plates	Under-charging Battery left in discharged state Under-temperature
Internal short-circuit	Material shed from plates trapped in fibre mat Faulty manufacture
External short-circuit	Faulty connections Lack of maintenance
Excessive gassing (leading to drying out and to bowing of cells)	Over-temperature Overcharging
Plate separation and grid corrosion	Decomposition of plate over time Inconsistent or faulty manufacture

“The only effective method of ensuring the battery back-up system is adequate....is by full and comprehensive cell-by-cell monitoring”

Professional Electrician

WHAT ARE THE BEST METHODS FOR GUARDING AGAINST BATTERY FAILURE?

Internal resistance measurement is the preferred method of monitoring batteries and detecting unhealthy battery cells. Monitoring systems that use this technique monitor uninterruptible power supply battery systems 24 x 7 and provide the best solution.

A suitable battery monitoring system should be able to collect and record data covering a whole host of conditions:

- Resistance
- Overall voltage
- Cell voltages
- Ambient temperature
- Cell or monobloc temperatures
- Float current
- Discharge current
- String currents
- Discharge time

“A battery monitoring system provides the final link in the chain of protection”

M&E Design Magazine

An extremely effective way of monitoring battery health is to use a series of data collection modules and control units which are networked together using fibre optics, into a kind of Cellwatch LAN (local area network).

The control units are connected to a central monitoring unit in the form of a specially configured laptop computer. This enables the continual measurement of cell or monobloc resistance providing a clear overall picture of the state of the battery. The control box gathers data on the total current into and out of the battery strings via hall effect transducers.

The laptop computer can be used to integrate with a building management system and/or a network management system in order to provide remote alarm notification.

If you are thinking of implementing a battery monitoring system, check to make sure you will get the critical features. A comprehensive monitoring system will provide you with:

- ✓ Individual battery voltage measurement
- ✓ String voltage measurement
- ✓ Individual monobloc resistance measurement
- ✓ Pilot monobloc temperature measurement
- ✓ String current measurement
- ✓ Ambient temperature measurement
- ✓ Fibre optic data transfer
- ✓ Graphical user interface
- ✓ Graphing/charting capability
- ✓ Total history trending
- ✓ Audible alarm
- ✓ On-screen data display
- ✓ Integrated diagnostics
- ✓ Immediate discharge analysis
- ✓ FMS gateway
- ✓ High multi-string capability
- ✓ High maximum string voltage (3000V)
- ✓ Remote monitoring capability
- ✓ CE/UL approved



WHAT ARE THE COST BENEFITS TO BUSINESS OF IMPLEMENTING A BATTERY MONITORING SYSTEM?

A battery monitoring system will ensure that a user is given advance notice of when a battery cell is failing and starting to deteriorate. This means it can then be systematically replaced without compromising the effectiveness of the UPS system.

A single cell failure is potentially all it takes to make the entire UPS battery unreliable.

The criticality of the role played by a battery system means that the monitoring system can offer an extremely fast return on investment. The cost benefits come in several forms:

1. Identification of a faulty cell that would otherwise have caused a system crash the very next time the mains/utility power failed;
2. The reduced cost of cell replacement due to the battery operating in more controlled conditions. If 10-year life cells fail within 4 to 6 years, as it is estimated that 70 per cent do, then the monitoring system can potentially save the cost of one entire battery replacement over the course of 10 to 12 years;
3. With a battery monitoring system employed, defective cells can be detected and replaced at an early stage. A simple load bank test can identify a problem with the total battery system's health, but this may result in a complete battery replacement. Some NDSL customers have calculated that this cost benefit alone will ensure the system pays for itself within 2 years;
4. If the battery is being constantly monitored, this alleviates the need for frequent discharging and significantly reduces the costs associated with this exercise;
5. Information from the Battery Monitoring System can be used to adjust the battery's operating environment to maximize the expected life of the battery.



HOW IMPORTANT IS IT TO HAVE A BATTERY MONITORING SERVICE PARTNER?

NDSL's CELLWATCH system meets all the requirements demanded of a modern day battery monitoring system. As part of the overall UPS continuity strategy, the following six monthly tests and procedures are also recommended:

- ✓ A physical check of each cell or monobloc for the onset of corrosion
- ✓ A physical check of the battery rack for mechanical security
- ✓ A check on the security of straps and battery terminals' nuts and bolts
- ✓ Cleaning and greasing of all terminals with anti-oxidation grease

A battery monitoring service partner can provide you with ongoing support to ensure that the above tests and procedures take place at regular intervals. This support is the final 'link-in-the-chain' that, in conjunction with an advanced battery monitoring system, will help ensure that your battery back-up facility will never let you down.